Section VIII - Evaluation and Comparison of Final Plans

The final alternative plans for a replacement lock at Chickamauga were evaluated based on the following standards: satisfaction of study needs, opportunities, objectives, contributions to Principles and Guidelines accounts, and responsiveness to specific evaluation criteria. The final plans being evaluated are replacement locks of differing dimensions and a congestion fee added to the without-project condition RIK.

1. Satisfaction of Study Needs

The needs addressed in this study are to provide for continued navigation through the Chickamauga Project and to insure continuation of Chickamauga's other project purposes. Both the 75'x400' and 110'x600' lock replacements will continue navigation through the Chickamauga project and insure continuation of Chickamauga's other project purposes. Navigation will continue during the construction of either of these two plans. A congestion fee by itself will not continue navigation through the Chickamauga Project, however, since it would be included with the without-project condition (RIK), the need for continued navigation at the project would be provided by the RIK.

2. Satisfaction of Study Opportunities

The consideration of alternatives for solving the existing lock's structural problems provides the opportunity to address Chickamauga's poor reliability and inadequate lock size. Both the 75'x400' and 110'x600' lock replacements will increase capacity of the Chickamauga project to differing degrees as discussed in Section VI. While the capacity of the 110'x600' lock (41.0 million tons) is more than twice the capacity of the 75'x400' lock (12.8 million tons and 16.8 million tons with helper boats), because of the low traffic demand, both lock sizes process the same amount of traffic. The congestion fee's intent is not to increase the capacity of the lock, but is intended to improve the economic utilization of the existing capacity. Capacity of the existing lock or of the

without-project condition (RIK) with or without a congestion fee is about 7.9 million tons without helper boats and 11.0 million tons with helper boats. It is evident that the larger lock plans provide significantly greater capacity than the existing condition with or without a congestion fee.

3. Satisfaction of Study Objectives

Five specific study objectives have been established for the Chickamauga Lock Feasibility Study. The following is a discussion on the extent each of the final alternative plans addresses these specific planning objectives (See Table VIII-1).

a. Continued and reliable navigation. The major objective of this study is to insure continued and reliable commercial navigation at the Chickamauga Lock and Dam Project. Through construction of a replacement lock at Chickamauga of any size, the reliability problems associated with the impact of AAR on the lock are effectively eliminated. With a replacement lock being located riverward of the existing lock and downstream of the dam, almost all impacts associated with AAR are avoided. Also, with any of the replacement locks, navigation would continue through the existing lock during construction.

Utilization of a congestion fee does not address the reliability issues associated with the existing Chickamauga Lock. However, when combined with the most likely without-project condition of a replacement-in-kind, the reliability issue is addressed. A RIK, like the other replacement locks, eliminates impacts associated with AAR and thus provides continued and reliable commercial navigation at Chickamauga.

b. Minimize maintenance closures. Because of the AAR problems associated with the existing lock, scheduled and unscheduled lock closures are occurring more frequently and for longer periods of time at Chickamauga. These closures have a significant negative impact on the users of Chickamauga lock. Any replacement lock will eliminate the AAR impacts and reduce both the occurrence and duration of scheduled and unscheduled lock closures.

A congestion fee does not address lock closure issues. However, when combined with the without-project condition of a replacement-in-kind, both the occurrence and duration of scheduled and unscheduled lock closures are significantly reduced. A RIK, like other replacement locks, eliminates impacts associated with AAR and thus eliminates the cause for most of the lock closures.

c. Reduce lockage-transit time (cost). The existing lock is very inefficient when processing tows. Tows average about one hour per barge to process through Chickamauga Lock. Fifteen-barge tows take 15 hours or more to process through the lock. The difference in processing time is directly related to the experience of the tow crew.

The without-project condition does not reduce lockage-transit times until helper boats are added late in the study period. However, the larger lock sizes included in the final analysis do reduce lockage-transit times over the existing lock or without-project condition. By providing larger chambers, more barges are locked in a single lockage, thus reducing the number of lockages required for a given tow size. Not only will the tow be processed more quickly, the time tows wait in queue will be reduced.

The congestion fee will reduce average transit time per tow by eliminating the marginal traffic competing for lockage time. Reduced demand reduces delay time which reduces the overall transit time as well. With a congestion fee, the average processing time in 2010 is expected to be 13.0 hours per tow. By the year 2060, the average transit time is anticipated to grow to about 23.8 hours per tow. The expected average processing times for the various alternatives are presented in Table VI-4.

d. Facilitate safe and efficient movement of traffic. As the number of tows increases and the number of lockages also increases, the likelihood of accidents and injuries increases. While data is not readily available to support this position, it is intuitive that the more a hazardous task is performed, the greater the probability of an accident.

Both replacement lock sizes reduce the processing times and the number of lockages over the without-project condition. This reduction in processing times will improve the efficiency of the movement of traffic through

the Chickamauga Lock Project. In addition, the process will be safer since the total number of lockages per tow will be reduced. In addition, the number of times the tows are separated and them remade will be significantly reduced. The process of breaking the tow (disconnecting the barges from each other or the towboat) and of making the tow (connecting the barges to each other or the towboat) is a very dangerous operation. By reducing the number of times these processes are performed will improve the safety of the movement.

The current lock is very inefficient in processing tows. As traffic grows over the study period, the 60'x360'lock will become even more inefficient. In addition, the poor reliability and unknown future of the existing lock has resulted in companies utilizing more costly overland modes. This means that commodities are not currently utilizing the most efficient mode of transportation. Both replacement lock alternatives will improve locking efficiency. By eliminating the reliability concerns and providing a more efficient less costly locking process, commodities would shift to the waterway adding efficiency in the movement of commodities on the Upper Tennessee.

Congestion fees will not improve the safe movement of those commodities utilizing the Chickamauga Lock. Since the lock chamber would remain 60'x360', the tows will still lock only one barge at a time with multiple cuts.

Congestion fees will have an impact on efficient movement of commodities. Economic efficiency is afforded to some extent by removing very marginal rate savers from the waterway, thus reducing delay for those movements remaining on the waterway. This produces some reductions to the total transportation costs for some commodities while increasing the total transportation costs for others. The economic advantage of this alternative occurs when the annual revenue received because of the congestion fee is subtracted from the total transportation costs.

e. Conserve fish and wildlife, recreation, and cultural and natural resources. All of the alternatives would cover approximately the same construction footprint and would have similar environmental impacts, particularly over the short term. All would have temporary negative

impacts on water quality, air quality, aquatic resources, upland vegetation, and noise.

Over the long term, however, these impacts disappear, and positive impacts become apparent. Aquatic habitat would be restored in the temporary channel and approximately 11 acres of new aquatic habitat would be established. Proper valve design will promote movement of migratory fish upstream.

A new lock will ensure the publics continued ability to transit between the Chickamauga and Nickajack Reservoirs. A larger lock would minimize delays due to waiting for commercial traffic to clear the lock, and thus would benefit the recreating public.

All of the plans studied, including closing the lock would have an adverse impact on the cultural context of the existing structure. Because of the other issues involved, however, there appear to be no alternatives to closing and plugging the lock. The State Historic Preservation Officer has been consulted and is providing input as to the best method of documenting the structure and minimizing the negative impacts.

The 110 x 600 foot lock provides better environmental benefits than either the without project alternative or the 75 x 400 foot lock alternative. In the long term the 110 x 600 foot lock will provide the greatest benefits to water and air quality, noise, and aquatic resources, as well as to socioeconomic factors such as shipper costs, river traffic, infrastructure, and intermodal shifts. Taking all of these factors into consideration, the 110 x 600 foot lock is the environmentally preferred plan.

Table VIII-1 Satisfaction of Study Objectives			
Study Objective	**WOPC With Congestion fee**	**75'x400'**	**110'x600'**
Continue Navigation	Yes	Yes	Yes
Continue Reliable Navigation	Yes	Yes	Yes
Minimize Lock Closures	Yes	Yes	Yes
Reduce Transit Time	Slight	Yes	Best
Facilitate Safe Movement of Traffic	Yes	Better	Best
Facilitate Efficient Movement of Traffic	Yes	Better	Best
Conserve Fish & Wildlife	Yes	Yes	Best
Conserve Recreation	Yes	Yes	Yes
Conserve Cultural and Natural Resources	No	No	No

4. Contribution to Principles and Guidelines Accounts

a. National Economic Development Account. A replacement lock at Chickamauga contributes to the National Economic Development (NED) Account in varying ways. NED navigation benefits consist of reductions in transportation costs for existing traffic moving on the waterway and for traffic moved to the waterway because of shifts in transportation modes due to the elimination of the reliability problems with the existing lock and through reduced waterway costs. Other NED benefits include reduction in repair costs associated with AAR, reduction in external costs resulting from both scheduled and unscheduled lock closures, elimination of helper boats at Chickamauga, and improvements in recreation benefits (minimal over the without-project RIK). The annual costs, cost reductions (benefits), and net reductions (benefits) for the two lock plans are shown in Table VII-4. When the

two lock plans are compared to the WOPC, the 75'x400' lock has an incremental annual net cost savings of $1,960,000 and the 110'x600' lock has an incremental annual net cost savings of $1,248,000. The congestion fee's contribution to the NED account when compared to the WOPC is an annual loss of $137,000.

b. Environmental Quality Account. Construction of any of the lock replacement plans will cause some unavoidable adverse impacts at the project site. Most, however, can be limited to relatively small geographic areas. The final two plans are at the same location, have the same major features and similar environmental impacts. The most significant impact will arise from widening and dredging a portion of the right descending bank just downstream of the railroad bridge to improve the lower approach channel to the existing lock. This work is required to continue navigation during construction of a replacement lock. This impact is the same under both plans. Two endangered mussels, pink mucket and orange-foot pimpleback have been identified as habituating this area. Mussels in the impacted area will be relocated before dredging begins. Material from the coffer cells may be placed in a portion of the dredged area to reestablish mussel habitat once the new lock is opened.

Material generated from the excavation of the replacement lock chamber will be placed in an area adjacent to a threatened plant, the mountain skullcap. A buffer will be maintained between the disposal area and the wildflower.

Physical alteration of the Chickamauga Lock and Dam and changes to the visual context of the adjacent Norfolk and Southern Railroad bridge will occur if a new lock is constructed. Similarly, construction activities in the general project area may adversely affect significant archeological properties. Resulting adverse effects will be addressed in a Memorandum of Agreement between the Corps of Engineers, Tennessee Valley Authority, and the Tennessee State Historic Preservation Officer (SHPO) stipulating how such adverse effects can be taken into account by avoidance, minimization, or mitigation. If they occur, adverse effects can be acceptably mitigated.

Table VIII-2 compares environmental impacts for all the final alternatives.

Table VIII-2 Comparison of Environmental Impacts

	RIK + Congestion Fee	75'x400' Lock	110'x600' Lock
Socioeconomics Overall	+	+++	+++
NED Benefits	-	+++	++
Shipper Costs	-	++	+++
River Traffic & Infrastructure	+	++	+++
Intermodal Shifts	+	++	+++
Recreation	+	+	+
Land Use	=	=	=
Water Quality – Short Term	-	-	-
Water Quality – Long Term	=	+	++
Air Quality – Short Term	-	-	-
Air Quality – Long Term	+	++	+++
Aquatic Resources – Short Term	-	-	-
Aquatic Resources – Long Term	+	++	+++
Wetlands	=	=	=
Upland Vegetation & Wildlife – Short Term	-	-	-
Upland Vegetation & Wildlife – Long Term	=	=	=
Threatened & Endangered Species – Long Term	=	=	=
Historic and Cultural Resources	--	--	--
Noise – Short Term	-	-	-
Noise – Long Term	=	+	++
Flood Control/ Floodplain	=	=	=

Note: - minor negative impacts, -- moderate negative impacts, --- severe negative impacts.
= no impact of existing conditions
+ minor positive impacts, ++ moderate positive impacts, +++ major positive impacts

The RIK with congestion fees would have impacts similar to the other replacement locks. However, the environmental advantages of fewer lockages per tow would not be realized and more traffic would remain on the overland modes.

c. Regional Development Account. The two replacement lock plans make positive contributions to the Regional Economic Development (RED) Account in the form of lower transportation costs. Lower transportation costs on the Upper Tennessee River will result in increased income to shippers and ultimately savings to consumers. While not included as a project benefit, the expenditures associated with construction of a replacement lock will have a significant impact to the economy of Chattanooga, Hamilton County and the surrounding area.

d. Other Social Effects Account. All the structural alternatives contribute positively to the Other Social Effects (OSE) Account by improving lockage operations – not only by reducing the risk of potential accidents, but also potential conflicts between commercial and recreational users. The 110’x600’ replacement lock reduces the risk of accidents and injuries more effectively because it reduces the number of lockages per tow to a maximum of two lockages. No displacement of homes or businesses is required with any plan. During project construction, increased noise and construction traffic could detract from the quality of the recreational experience in the immediate project area. Other impacts include the diversion of traffic along Access Road and Lake Resort Drive during relocation of these facilities. This impact is the same for any of the plans being considered.

5. Responsiveness to Evaluation Criteria

Principles and Guidelines stipulate that alternative plans should be formulated and evaluated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability. The following is a summary of these evaluations.

a. Completeness. The term “completeness” refers to the extent to which an alternative plan provides and accounts for all investments or other actions necessary to ensure the realization of the planned effects. Each of the

final plans is equally complete in that all investments and actions for a replacement lock at the Chickamauga Project are accomplished during an initial construction phase. However, for the congestion fee plan, the replacement-in-kind (WOPC) will have to be constructed before this plan is considered complete.

b. Effectiveness. "Effectiveness" refers to the extent to which an alternative alleviates specified problems and achieves desired outputs. The final structural plans are effective because each includes a replacement lock that would eliminate the impacts of AAR on the lock, reduce lock closures, and increase lock capacity. The 110'x600' lock is considered more effective since it would provide the greater lock capacity.

The congestion fee by itself is not considered effective since it does not address the structural problems associated with AAR nor does it increase the capacity of the project. However, when combined with the WOPC (RIK), it does address the AAR problems. The congestion fee option is the least effective alternative considered.

c. Efficiency. "Efficiency" refers to the extent to which an alternative is the most cost-effective means of alleviating the specified problems and achieving the desired output. Maximum net benefits are the best means for measuring efficiency. Both replacement lock alternatives have positive net benefits. However, the 75'x400' lock alternative is the most efficient plan considered. Net benefits for the 75'x400' are $712,000 greater than for the 110'x600' lock. The congestion fee produces a negative net benefit of $77,000 indicating its lack of economic efficiency.

d. Acceptability. "Acceptability" refers to the viability of an alternative plan as viewed by federal, state and local entities and the general public, and its compatibility with existing laws, regulations and public policy.

TVA, in conjunction with agencies cooperating in the preparation of the EIS, held a public meeting on May 18, 1995, at Chattanooga State Technical Community College to receive comments on the draft EIS. About 60 people attended the meeting including representatives from industry, the public, state and local government,

congressional staff, U.S. Department of Energy, U.S. Coast Guard, U.S. Fish and Wildlife Service, and U.S. Army Corps of Engineers. In addition, TVA received written comments from Federal, state and local agencies, and industry. Written comments were also received from individuals and special interest groups. The majority of comments supported the replacement of the Chickamauga Lock. The main environmental concerns expressed were increased timber harvesting, water quality, aquatic biology impacts and increased flooding.

Several letters supporting construction of a new 110'x600' lock at Chickamauga have been received in response to the Corps' public announcement of intention to prepare a supplement to TVA's 1996 FEIS. No dissenting letters were received.

The Inland Waterways Users Board in their 15th Annual Report to the Secretary of the Army and the United States Congress dated August 2001 states:

"The lock and dam at Chickamauga Lock on the Tennessee River, Tennessee, owned by the Tennessee Valley Authority (TVA) are badly deteriorating from adverse reactions of the aggregate used to build the facility. Despite the many efforts of TVA and the U.S. Army Corps of Engineers to offset the effects of the deterioration, the facility will permanently shut down in several years due to its condition. The Board recognizes a need for action to be undertaken at this location before the facility is forced to close. If this navigation facility were to be closed, hundreds of miles of navigable waterways on the upper reaches of the Tennessee River would be eliminated."

Construction of a new lock at Chickamauga is compatible with existing laws, regulations and public policy.

6. National Economic Development Plan

The plan that reasonably maximizes net contributions to the national economic development account is designated the National Economic Development (NED) Plan. Plan efficiency was discussed above under responsiveness to evaluation criteria. The 75'x400' replacement lock has net incremental annual cost reductions of $1,960,000 when

compared to the WOPC whereas the 110’x600’ replacement lock has net incremental annual cost reductions of $1,248,000 when compared to the WOPC. The congestion fee in combination with the WOPC has a net incremental increase in annual costs by $137,000 when compared to the WOPC. The 75’x400’ lock alternative has the greatest net cost reductions (benefits) and it is therefore designated the NED plan.

7. Sensitivity Analysis

a. General. The alternative plans for improving the existing project at Chickamauga are evaluated using the most probable future navigation conditions under both the with and without project alternatives. In defining these conditions, certain key assumptions and predictions regarding the future were made. Since future conditions cannot be predicted with certainty, tests were performed to describe the sensitivity of NED plan identification to changes in certain formulation variables.

b. High and Low Alternative Traffic Forecasts. The forecast of future traffic demands is one of the major factors affecting the need for improvements at Chickamauga. Traffic demands were projected to grow at a modest rate of 0.8 percent, owing to the expectations of electric utility companies, as well as the plans and responses of public terminals and manufacturers along the Upper Tennessee. Other traffic demands, either higher or lower than those presented, are possible. To show the sensitivity of the project to alternative traffic demand forecasts, net benefits for the alternative lock plans were re-evaluated based on alternative traffic projections.

High and low alternative forecasts were developed by reference to DOE’s 2001 Midterm Energy Forecasts and to the output of the ORS utility coal model. ORS utility coal model output was used to adjust the assumptions surrounding the addition of coal fired capacity in the markets served by an improved Upper Tennessee River. The DOE forecasts were used as a broad indicator of variation in future economic growth.

The Ohio River System utility coal model forecasts generation and coal burn at utility plants receiving Ohio River System coal. A key assumption in the preceding

analysis affecting the utility coal forecast is that future capacity additions at the utilities with plants receiving coal off the Upper Tennessee will be entirely gas-fired. This assumption was made based on information supplied by Southeastern utility representatives during a basin-wide utility survey conducted as part of the Ohio River Mainstem Study. This assumption had a marked effect on the growth of potential utility coal traffic originating on the Upper Tennessee. As a part of the high traffic demand forecast, the assumption of no new coal-fired capacity at the affected utilities was relaxed. It was assumed that capacity would be added, as needed, at existing sites in proportion to the then-existing generation mix. The most likely utility coal traffic demand forecasts was adjusted upward to reflect this less constrained assumption.

DOE develops three alternative forecasts for energy production and consumption at the national level along with baseline regional forecasts, the Southeast region among them. DOE's high and low alternatives reflect varying assumptions with respect to growth in the labor force and productivity. Factors were developed to reflect high and low electricity generation. The high factor was applied to the receipts of Upper Tennessee utility coal, which had been previously adjusted to reflect the addition of coal-fired capacity. Factors were also developed reflecting high and low industrial energy consumption, which were applied to the most likely level of receipts or shipments of all other commodities. The adjusted traffic demands resulting from the high and low sensitivities as well as the most likely forecast are displayed in Table VIII-4.

In addition to the high, low and most likely traffic demand forecasts, a fourth alternative was developed reflecting no growth in traffic demand beyond what was reflected in the 2000 traffic demand estimate. The resulting traffic demand numbers are also displayed in Table VIII-3.

Table VIII-3 Alternative Traffic Demand Projections Upper Tennessee River System, 1996-2060 (Thousands of Tons)				
Year	**No Growth**	**Low Growth Forecast**	**Most Likely Forecast**	**High Growth Forecast**
1996 Base	6699	6,669	6,669	6,669
2000	7,564	7,564	7,590	7,602
2010	7,564	8,009	8,287	8,403
2020	7,564	8,195	8,782	9,781
2030	7,564	8,502	9,404	11,125
2040	7,564	8,971	10,213	12,544
2050	7,564	9,310	10,878	13,680
2060	7,564	9,469	11,326	14,508
Annual % Change	0%	0.5%	0.8%	1.2%

c. Results of Traffic Sensitivities. The sensitivity analyses were conducted only for the alternatives involving construction of larger locks. The congestion fee alternative was not re-evaluated. Results of the sensitivity analysis are displayed in Table VIII-4. Under all forecasts, both alternatives produce positive net benefits. Net benefits are again maximized by the 75'x400' lock. With no growth in traffic demand after year 2000, it is important to note that a replacement-in-kind remains justified as the without-project condition, having net benefits amounting to about $10.7 million.

The sensitivity test shows that net benefits are fairly sensitive to the alternative traffic demand forecasts, with a disparity of over 5 million dollars between the high and no growth alternatives for each lock size. Under the high traffic demand forecasts, net benefits are about 226 percent higher than the most likely for the 75'x400' lock size and 383 percent higher for the 110'x600' lock size. For the no growth traffic demand forecasts, net benefits are 35 percent lower than base

level for the 75’x400’ lock size and 88 percent lower for the 110’x600’ lock size.

Table VIII-4 Sensitivity of Net Benefits to Alternative Traffic Demand Projections (Thousands of FY 2001 dollars)

Alternative Plans	No Growth Forecast	Low Growth Forecast	Most Likely Forecast	High Growth Forecast
75’x400’	1280	1,311	1,960	6,397
110’x600’	148	676	1,248	6,023

d. Interest Rate. In addition to the alternative traffic demand forecasts, an interest rate sensitivity test was performed to determine the interest rate that would reduce net benefits to zero and the benefit-cost ratio to unity. This is the internal rate of return for water resources projects. The calculation was conducted for the two locks. For the 75’x400’ an interest rate of 16.296 percent will reduce net benefits to zero. The comparable interest rate for the 110’x600’ lock is 9.264 percent.

8. Congestion Fee

As previously discussed, a congestion fee is a non-structural measure that serves as a rationing device to restrict demand for lock use and induce shippers to choose alternative routings or other modes of transportation. Congestion fees were evaluated in the study to determine their impact in reducing congestion at Chickamauga Lock and their impact on transportation rate savings.

The use of a congestion fee in combination with the without-project condition (RIK) has negative average annual benefits of $77,000. Therefore, a congestion fee is not economically justified. In addition, other problems with the congestion fee make it undesirable. It does nothing to increase the capacity of the RIK. It merely shifts traffic from the otherwise more efficient waterway routing to the more costly overland route. As a result, some shippers will see an increase in transportation costs instead of a reduction. Additionally, the economic benefits are

considered very speculative. Since this alternative has never been implemented on a navigation project, there is no experience for judging its actual performance. There is a high risk that it would not perform as well as the theoretical model. Finally, congestion fees are strongly opposed by the towing industry and other regional waterway interests. The added government regulation would increase production costs, erode their competitive advantage relative to other competing modes and waterways, and hinder their ability to compete in national and international markets.